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A REVIEW OF THE ATHERINE FISHES OF JAPAN.

BY

DAVID STARR JORDAN

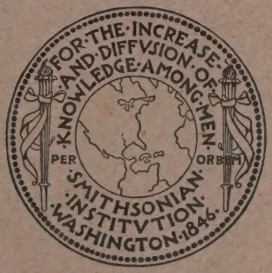
AND

EDWIN CHAPIN STARKS,

Of the Leland Stanford Junior University.

From the Proceedings of the United States National Museum, Vol. XXIV, pages 198-206.

[No. 1250.]



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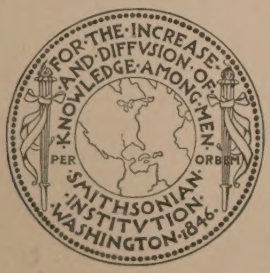

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A REVIEW OF THE ATHERINE FISHES OF JAPAN.

By David Starr Jordan and Edwin Chapin Starks,

Of the Leland Stanford Junior University.

In the present paper is given an account of the Japanese species of Atherinidæ. It is based on the collections made in 1900 by Messrs. Jordan and Snyder and upon the specimens contained in the United States National Museum. The drawings are by Mrs. Chloe Lesley Starks.

Family ATHERINIDÆ.

THE SILVERSIDES.

Body rather elongate, somewhat compressed, covered with scales of moderate or small size, which are usually, but not always, cycloid. No lateral line; some scales often with rudimentary mucous tubes. Cleft of the mouth moderate. Teeth small on jaws and sometimes on vomer and palatines, rarely wanting. Premaxillaries protractile or not. Opercular bones usually without spines or serrature. Gill openings wide, the gill membranes not connected, free from the isthmus; gills 4, a slit behind the fourth. Pseudobranchiæ present; gill-rakers usually long and slender. Branchiostegals 5 or 6. Dorsal fins 2, well separated, the first of 3 to 8 slender flexible spines, the second of soft rays; anal with a weak spine, similar to the soft dorsal, but usually larger; ventral fins small, abdominal, not far back, of 1 small spine and 5 soft rays; pectorals moderate, inserted high. Air bladder present. No pyloric cœca. Vertebræ numerous, usually about $23+23=46$; third and fourth superior pharyngeals coossified, with teeth. Carnivorous fishes, mostly of small size, living in great schools near the shore in temperate and tropical seas; a few species in fresh water. All the species have a silvery band along the side; this is sometimes underlaid by black pigment. All of them which are large enough are highly valued as food.

a. Premaxillaries protractile, the skin not continuous with that of the forehead.
b. Premaxillary narrow posteriorly, its edge nearly straight.
c. Body little compressed, the belly rounded; pectorals short; scales cycloid; vomer with teeth; first dorsal with 5 or 6 spines, inserted in front of the rather short anal; mouth short.
d. Head without spines ..... *Atherina*
dd. Head with rows of small sharp spines along the various ridges. *Atherion.*
cc. Body much compressed, the breast compressed to a sharp edge; belly (in male) with a fleshy fold ..... *Iso*

ATHERINA (Artedi) Linnæus.

FRIARS.

Atherina (Artedi) Linnaeus, Syst. Nat., 10th ed., 1758, p. 315 (*hepsetus*).
Membras Bonaparte, Fauna Italica, 1836 (no type indicated).

Body oblong, compressed. Mouth large, terminal, oblique; jaws about equal, their edges nearly straight; maxillary extending to the front of eye. Premaxillaries narrow posteriorly, strongly protractile. Villiform teeth in bands on jaws, vomer, and palatines. Species numerous, mostly European.

(ἀθερίνη, the ancient name, from ἀθήρ, a spike or arrow.)

a. Vent between the ventral fins.
b. Scales with entire edges, about 40 in number; lateral band narrow..*woodwardi*
bb. Scales obtusely denticulate, about 45 in number; lateral band broader.*bleekeri*
aa. Vent well behind tip of ventrals; scales 45; scales with entire edges.....*tsurugæ*

ATHERINA WOODWARDI Jordan and Starks, new species.

Atherina ? pinguis Ishikawa, Prel. Cat., 1897, p. 33, Okinawa, Miyakoshima, Riukiu Archipelago, not of Lacépède.

Head $4\frac{1}{4}$ in body without caudal; depth $5\frac{1}{4}$. Eye $2\frac{2}{3}$ in head; snout 4; maxillary $2\frac{3}{5}$. Dorsal V–I, 10; anal I, 12. Scales 40, transverse 6.

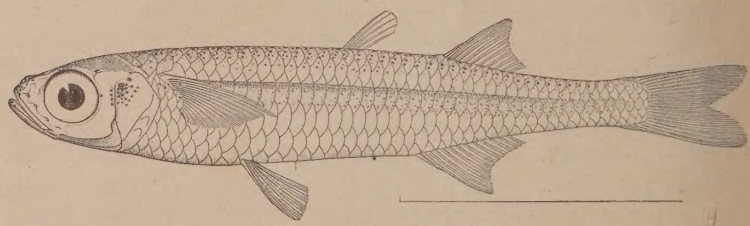

Fig. 1.—Atherina woodwardi.

Mouth moderate in size, the maxillary reaching to just past anterior orbital rim. Teeth very small, in narrow bands on jaws and vomer. Gill-rakers slender, about half eye in length, their number about 6 + 16.

Head as viewed from above essentially as here described for *A. bleekeri* and with the same ridges.

Cheeks and suborbital region evidently with scales, though but two or three scales remain on head on our specimens. Scales on body with entire edges. Fifteen scales in the median series on back before spinous dorsal, and 7 between dorsal bases.

Origin of ventrals midway between front of anal and middle of eye; distance between front of first dorsal and front of second $1\frac{2}{3}$ in head. Pectoral reaching to above first third of ventrals. Vent between ventrals as in *A. bleekeri*.

Color probably silvery; the back very sparsely covered with coarse brown dots set more or less in rows. A rather narrow silvery lateral

band bordered with black above is nearly confined anteriorly to the third row of scales below superior median series. Its posterior two-fifths being slightly wider and the scales being smaller it involves the lower edge of the second row of scales and the upper edge of the fourth; its anterior end does not show above upper edge of pectoral. Tip of snout dusky with brown dots. Opercles silvery. Another series of specimens from the same locality, probably owing to a different method of preservation, are more silvery with the lateral band not so conspicuous and with the border above it not so dark.

This species differs from *A. valenciennesii* and *A. bleekeri* in having scales with entire edges, and from the latter particularly in having fewer scales.

The type and 7 cotypes are from Okinawa, in the Riukiu group. The former bears the number 6529 on the catalogue of the Leland Stanford Junior University Museum. It was numbered 566 in the Imperial Museum of Tokyo, a type specimen being presented by Dr. Ishikawa. Others numbered 567, from Miyakoshima, are in the Imperial Museum.

The junior author wishes to name this species for Dr. Smith Woodward, of the British Museum, as a slight acknowledgment of the interest Dr. Woodward has shown in his work on fish osteology.

ATHERINA BLEEKERI Günther.

Atherina japonica Bleeker, Verh. Bat. Gen., XXV, Japan, p. 40, fig. 2, Nagasaki, (not of Houttuyn).

Atherina bleekeri Günther, Cat. Fish., III, 1861, p. 398, China.

Atherinichthys sp. Ishikawa, Prel. Cat., 1897, p. 33, Ise, No. 565.

Atherina valenciennesi Nystrom, Kong. Svensk. Ak. Vet., 1887, p. 38, Nagasaki (not of Bleeker).

Head $4\frac{1}{2}$ in body without caudal; depth $5\frac{2}{3}$. Eye 3 in head; snout 4; maxillary $2\frac{2}{3}$. Dorsal VI–I, 10; anal I, 13; scales 45; transverse series 7.

Mouth rather oblique and moderate in size; the maxillary reaching just past the anterior orbital rim; jaws about equal. Teeth very small, in bands on jaws and vomer. Gill-rakers slender, in length a little less than the diameter of pupil; about 19 present on lower limb of arch.

Nasal bones forming a ridge or angle continuous with supraorbital rim making the head as viewed from above flat, with the lateral edges straight and gradually approaching each other as a long triangle, and with the apex cut squarely off or bluntly rounded at tip of snout. Distance across tip of snout $1\frac{1}{8}$ in interorbital space, which is a little greater than diameter of eye. A broad low ridge decreasing in size anteriorly extends from the first scales on top of head to anterior interorbital edge where a depression separates it from a ridge on middle of snout formed by the process of premaxillaries. These ridges are partly formed by a depression on each side of them.

Scales on back extending over occiput to posterior margin of eyes; a few scales behind and below eye; head otherwise naked. Scales on body obtusely denticulated; fins scaleless. In a median line on back before dorsal are 20 scales, and between the bases of dorsals are 8.

Origin of soft dorsal about over the first third of anal base, the tips of its rays extending a little beyond those of anal. Origin of ventrals nearer front of anal base than tip of snout by a distance equal to diameter of eye. Pectoral reaching slightly past origin of ventrals. Origin of first dorsal before that of second a distance contained $1\frac{1}{4}$ in length of head. Vent between ventrals, midway between their tips and base.

Color.—Edges of scales of back broadly edged with blackish or dusky; this more pronounced on back as viewed from above. Top of head and tip of snout black. Tip of mandible variously dusky or colorless. Lateral band silvery, dark above; occupying nearly the entire third and upper half of fourth series of scales below median series of back. Ventrals and anal colorless. Dorsals and caudal dusky. Pectoral dusky at base.

This species is represented in great abundance in the Japanese collection. Specimens were obtained from the following localities. Tsuruga, Tokyo, Misaki, Wakanoura, island of Numata, Hakata, Nagasaki. It is everywhere common in sandy bays from Tokyo southward to Kiusiu.

Here described from a specimen $5\frac{1}{4}$ inches in length from Misaki, Sagami, Japan.

Of 16 other specimens counted, 11 have 5 spines in the first dorsal, while 5 have 6 spines. The soft dorsal varies from I, 9 to I, 10, and the anal I, 11 to I, 12.

(Named for Pieter van Bleeker.)

ATHERINA TSURUGÆ Jordan and Starks, new species.

Head $4\frac{1}{2}$ in body without caudal; depth $5\frac{3}{5}$. Eye $2\frac{3}{4}$ in head; snout $3\frac{1}{2}$; maxillary 3. Dorsal V–I, 10; anal I, 12. Scales 45; transverse series 7.

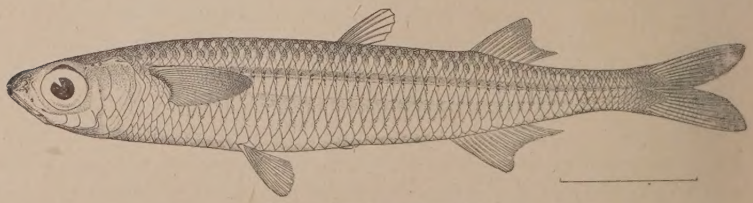

FIG. 2.—ATHERINA TSURUGÆ.

The maxillary reaches scarcely past anterior orbital rim. Jaws about equal. Teeth very small, in narrow bands on jaws and vomer. Gill-rakers slender; the longest about $2\frac{1}{3}$ in eye; their number about 6 + 21.

The interorbital space is a little greater than the diameter of the eye. The shape of the head and the ridges are as described for *A. bleekeri*.

Scales with entire edges; their number and arrangement as in *A. bleekeri*.

Origin of soft dorsal about over the first fourth of anal. Origin of ventrals midway between front of anal and anterior orbital rim. Pectoral reaching a little past front of ventrals. Origin of spinous before that of soft dorsal a distance contained $1\frac{1}{10}$ in head.

Vent a little over half the length of ventrals posterior to the tips of those fins.

Color.—Sides silvery. Lateral band silvery bordered above with dark blue, occupying the third and part of the fourth series of scales. Top of head and a border to scales of back an opaque cobalt blue. This sometimes more or less replaced on scales by dark brown or black, but the blue is nearly always present as small dots on the median row of scales of back and may be seen by the aid of a magnifier. Pectoral dusky at tip. Ventrals and anal colorless. Dorsals and caudal dusky.

This species differs from *A. bleekeri* in having scales with entire edges, in having the top of head a conspicuous cobalt, in having the pectoral tipped with dusky, and particularly in having the vent much more posterior, which character will at once separate the species.

The type is 132 mm. in entire length and is from Nagasaki, Hizen, Japan, where many cotypes were taken. Other specimens are from Misaki and Tsuruga.

The type bears the number 6530 on the Leland Stanford Junior University Museum Register.

ATHERION Jordan and Starks, new genus.

This genus differs from *Atherina* in having small, sharp, tooth-like spines set in rows on the head. Maxillary anteriorly covered with them, a row following lower edge of mandible and another along inner under edge; these continue along interopercle and anterior part of subopercles as a band of scattered spinules; a row along lower limb of preopercle; a row on preorbital; and a row on superior orbital rim.

It also differs from the known Japanese species of *Atherina* in having the vent near front of anal.

(Diminutive of ἄθηρ, the rough spike of wheat.)

ATHERION ELYMUS Jordan and Starks, new species.

Head 4 in body without caudal; depth 6. Eye 3 in head; snout 4. Dorsal V-I, 11; anal I, 16. Scales 43; transverse 7.

Mouth oblique and very small; the maxillary not nearly reaching to eye. Teeth evident on jaws, and apparently the whole roof of the mouth is granulated. Interorbital wide and convex, its width greater than diameter of eye. Top of head smooth, convex, and without

ridges. The supraorbital rim separated from central portion of interorbital space by a depression. Head with rows of small, sharp, and tooth-like spines, as described for the genus.

Opercles with three or four large scales, and cheeks and suborbital region with scales. Scales on body with entire edges. About 16 scales in the median series in front of dorsal. Second dorsal originating nearly above middle of anal, and extending a little posterior to it. Front of spinous dorsal before front of soft dorsal a distance contained $1\frac{1}{2}$ in head. Pectoral reaching to above middle of ventrals. Origin of ventrals midway between the vertical from middle of eye and front of anal. Vent near front of anal.

Color slaty, no silvery apparent except a trace at opercles. Scales

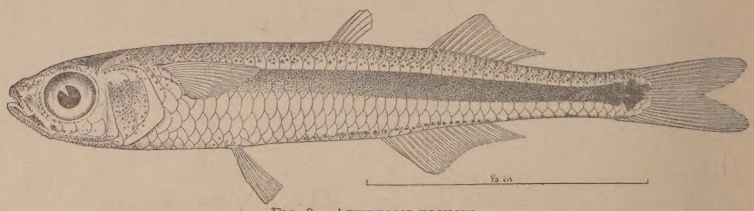

FIG. 3.—ATHERION ELYMUS.

of back each with a large blackish spot. Top of head and snout black. Lateral edge of lower jaw black. A black lateral stripe on third and part of fourth rows of scales, growing broader at about its middle, thence narrower at caudal peduncle and again expanding at base of caudal fin, somewhat involving base of caudal rays. Fins without color, except caudal, which is slightly dusky.

The largest specimen is 38 mm. in length. About a dozen specimens were taken in tide pools at Misaki, Sagami, Japan. The species seems to reach only a very small size.

The type here described is about 33 mm. in entire length, and is numbered 6528 on the register of the Leland Stanford Junior University Museum.

(*Elymus*, rye-grass, from the rough head: ἔλυμος, a quiver).

ISO Jordan and Starks, new genus.

Body elongate, strongly compressed, deepest at nape, anteriorly scaleless. Breast compressed to an edge. Belly with a thick, sharp, fleshy fold of skin, at least in the male. Vertebræ about 43. Head short and blunt. Mouth small, oblique. Premaxillaries protractile but not movable. Pseudobranchiæ present. The gills, except the first, which is free from the second, are separated only by a short slit at the angle. Last gill with a slit behind it. Gill-rakers slender, about 4 + 13 in number. Gill membranes separate and free from the isthmus. Scales entire. First dorsal well separated from the second.

Second dorsal shorter than anal and similar to it. Caudal forked. Body with a wide black and silvery lateral band in strong contrast to body color.

(*Iso Iwashi*, surf-sardine; the Japanese name.)

ISO FLOS-MARIS Jordan and Starks, new species.

ISO-IWASHI (SHORE SARDINE); NAMI-NO-HANA (FLOWER OF THE WAVE.)

Atherinidæ ? Genus ? Species ISHIKAWA, Prel. Cat., 1897, p. 33, Boshu, Hashigo, Nos. 568, 569.

Head $5\frac{2}{3}$ in body without caudal fin; depth 5. Eye 3 in head; maxillary 3; pectoral $1\frac{1}{3}$; depth of head 1. Anal I, 23; dorsal IV—I, 16. Scales about 59; vertebræ 18+25=43.

Body strongly compressed and deepest at pectorals. Dorsal profile obtusely rounded at snout, thence rather slightly and evenly rounded to second dorsal and becoming straight at the long caudal peduncle. Ventral profile with a sharp regular curve from tip of lower jaw to ventrals, thence almost straight to caudal. Body as viewed from before

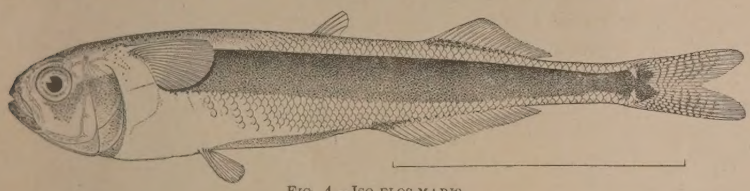

FIG. 4.—ISO FLOS-MARIS.

over twice as deep as wide; the back rounded; the greatest width in the upper third or fourth; thence tapering wedgelike to the sharp breast. The anterior part of sides of body and head flat below the temporal region.

Mouth small and very oblique; its angle about 45 degrees. The maxillary scarcely reaches to the vertical from the anterior rim of the orbit while the angle of the lower jaw reaches very slightly past. Mandible triangular in shape, three-fourths as wide as long. When the mouth is closed the mandible closes tightly within the maxillaries and upper jaw leaving the latter slightly projecting.

Teeth very small on jaws, vomer, and palatines, those on the jaws in a very narrow band. Snout a little shorter than the diameter of eye. Interorbital space a little wider than eye.

Gillrakers slender, about two-thirds the diameter of the eye in length; their number about 4+13. The first and second gill arches entirely free from each other as usual, but the second and third, and the third and fourth are separated only by a short slit which is not longer than eye at about the angle; the fourth gill with only a tiny slit behind it.

Head entirely scaleless. Scales with entire smooth edges; those on anterior part of body variable; on some specimens the side is naked

anterior to a little behind the pectoral fin while the back and belly are naked anterior to the spinous dorsal and the vent; on others a few scales extend to a little in front of the ventrals, and nearly to the base of pectoral, while on the back they are present a short distance in front of the spinous dorsal. Between these two extremes are all gradations.

Pectoral broad and short, with a bluntly curved posterior outline; its tip in some specimens reaches slightly more than halfway between its upper base and spinous dorsal; in others scarcely halfway. Origin of ventrals about under the last fifth of pectoral fin; their length equal to snout and half eye. Front of spinous dorsal a little nearer snout than base of caudal fin (by from diameter of pupil to diameter of eye), and much nearer anterior end of anal base than base of ventrals. Base of second dorsal shorter than that of anal by a distance equal to a little more than diameter of eye; it ends a little posterior to anal. Second dorsal rays anteriorly a little higher than those of anal, which are higher than dorsal spines. Distance between front of first dorsal and front of second dorsal a little greater than the base of the latter, which in turn equals the length of caudal peduncle. Upper lobe of caudal equals the head's length. Belly with a thick sharp fleshy fold of skin. In two females with eggs this flap is absent.

Color.—Body probably translucent in life, colorless in spirits, with a broad lateral blackish and silvery band running from base of pectoral to base of caudal; its width near pectoral about equal to length of ventrals, growing somewhat broader posteriorly and reaching its greatest width behind its middle, thence growing narrow on caudal peduncle and broadening at base of rays, where a V-shaped area constricts it above and below, thence continuing on base of caudal rays as a double spot. The band black, with more or less silver diffused over it, except at its upper edge. Lower jaw dusky; top of head and snout with black markings. A double row of dots from first dorsal to occiput, with sometimes other scattering dots. Behind first dorsal is a broken band of dots, parting to run each side of second dorsal and continuing on caudal peduncle as a double row of dots or a diffused band. At shoulder is a dusky spot which is sometimes replaced by scattered dots. Opercles and cheeks more or less dusky. A dark spot at anterior anal base. Caudal finely marked with transverse zigzag dark bands.

This pretty little fish is common in the surf breaking into tide pools about Sagami and Izu, where numerous specimens were taken, the largest about 2½ inches in length. Our specimens are from Enoshima, Misaki, Hada, Yogashima, and Hashigo, the last presented by Dr. Ishikawa. It is known to fishermen as Iso-iwashi or surf sardine, and as Namino-hana or flower of the waves.

The type, numbered 6527, in the Leland Stanford Junior University Museum catalogue.

(*Flos*, flower; *maris*, of the sea.)